ANIMAL HUSBANDRY DIVISION
HAWAII AGRICULTURAL EXPERIMENT STATION
HONOLULU, HAWAII

Under the joint supervision of the

UNIVERSITY OF HAWAII
and the
UNITED STATES DEPARTMENT OF AGRICULTURE

Progress Notes on Experiments and Other Items of Interest

No. 2 October, 1933

These progress notes on experimental work and other items of interest to livestock men in the Territory are issued from time to time by the Animal Husbandry Division. You are invited to suggest other lines of research that you deem important and to submit inquiries to the University.

HIGH PROTEIN RATION TO DAIRY COWS

Many dairymen in Hawaii seem to be feeding rations supplying about 50 per cent more protein than suggested by the Morrison standard. They contend that this larger amount of protein is necessary in order to get maximum milk production.

Experiment stations in general recommend that feeding more protein than required according to the Morrison standard does not seem justified by experimental evidence and frequently increases the cost of the ration.

In spite of this, many dairymen, not only in Hawaii but on the mainland as well, feed a rather high protein content ration. In Hawaii the cost of a high protein ration is little more than a lower protein content ration because soybean oil cake meal, so frequently used to bring up the protein, costs little more than relatively low protein feeds like corn.

In view of this situation and particularly since practically all the work on amount of protein to feed dairy cows has been done in the temperate zone, it seemed that the Hawaii Experiment Station,

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HIGH PROTEIN RATION TO MILKY COWS

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In view of this situation and particularly since practically all the work on amount of protein to feed dairy cows has been done in the temperate zone, it seemed that the Hawaii Experiment Station,

located right on the edge of the tropics, should do some further work on this problem.

The first work was more in the nature of an observation test started on October 1, 1931 and consisted of feeding rations, containing about 50 per cent more protein than was normally fed to the University dairy herd, to some ten cows for periods varying from a few months to eleven months in the case of one cow. But lacking exact checks the results were rather inconclusive and so a more definite experiment was planned and started April 28, 1932 and continued for 15 weeks through August 10, 1932.

Plan of the Experiment

Eight purebred dairy cows were divided into two lots of four each, Lot A and Lot B. In dividing these cows, reaction to Bang test, age, number of days since last calving, date due to freshen, and production were considered, thus making the two lots as equal as possible.

The reversal system of feeding was followed. Lot A was started on the X ration (normal protein or basal feed) and after five weeks was shifted to the HP ration (High Protein mixture) and after another five weeks was again shifted back to the X ration for the last five weeks of the fifteen-week test. Lot B was started on the HP ration, shifted to the X ration and then back to the HP ration, the change in feed in both Lots A and B being made at the same time.

The last four weeks of each five-week period were used in computing results. The mean of the first and third periods of each lot was compared with the results of the second or middle period in order to compensate for the decreasing production due to advancing lactation.

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Eight purebred dairy cows were divided into two lots of four each, Lot A and Lot B. In dividing these cows, reaction to Bang test, age, number of days since last calving, date due to freshen, and production were considered, thus making the two lots as equal as possible.

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The last four weeks of each five-week period were used in computing results. The mean of the first and third periods of each lot was compared with the results of the second or middle period in order to compensate for the decreasing production due to advancing lactation.

All the cows received the same roughages and beet pulp. Individual records of feed consumed, milk production, butter fat tests, and body weights were obtained and recorded.

Feed Prices

The prices of feedstuffs prevailing at the time of this experiment were as follows:

Roughages	Price per ton		
Green Alfalfa	$10.00	Assumed	value
" Sudan	7.00	"	"
" Napier	6.00	"	"
" Pigeon Pea Tops	7.00	"	"
Miscellaneous Grasses	4.00	"	"
Concentrates			
Rolled Barley	24.00		
Corn Meal	33.00		
Wheat Bran	25.00		
Coconut Oil Cake Meal	33.00		
Linseed Oil Cake Meal	39.00		
Soybean Oil Cake Meal	33.00		
Beet Pulp	29.00		
Raw Rock Phosphate	31.00		
Salt	14.00		

Feed Mixtures and Roughages

Average daily roughage fed each cow.

		Pounds Digestible		Assumed
		Protein	Total Nutrients	Cost
11.3 lbs.	Green Alfalfa	.53	1.6	$0.056
17.6 "	" Sudan	.14	2.4	0.062
5.9 "	" Napier	.07	0.7	0.017
16.2 "	Miscellaneous Grasses	.13	2.3	0.032
1.2 "	Pigeon Pea Tops	.06	0.2	0.004
52.2 "	Mixture	.93	7.2	$0.171

Milk was received the same roughage and beet pulp. Individual records of feed consumed, milk production, butter fat tests, and body weights were obtained and recorded.

Feed Prices

The prices of feedstuffs prevailing at the time of this experiment were as follows:

Roughage	Price per ton	
Green Alfalfa	$12.00	Assumed value
" " Sudan	7.00	"
" " Millet	6.00	"
" " Napier	7.00	"
" " Pigeon Pea Tops	4.00	"
Miscellaneous Grasses	4.00	"

Concentrates	
Rolled Barley	27.00
Corn Meal	33.00
" Meal Bran	27.00
Cocoanut Oil Cake Meal	27.00
Linseed Oil Cake Meal	27.00
Soybean Oil Cake Meal	27.00
Beet Pulp	25.00
Raw Rock Phosphate	21.00
Salt	14.00

Feed Mixture and Roughage

Average daily roughage fed each cow.

		Pounds Digestible Protein	Total Nutrients	Assumed Cost
1b.3 lbs.	Green Alfalfa	.53	1.6	$0.056
7.6 "	" Sudan	.14	2.4	0.032
4.0 "	" Napier	.07	0.7	0.027
14.2 "	Miscellaneous Grasses	.13	2.3	0.055
1.2 "	Pigeon Pea Tops	.06	0.2	0.004
52.2 "	Mixture	.93	7.2	$0.171

X Ration (normal protein mixture)

			Pounds Digestible		Actual
			Protein	Total Nutrients	Cost
75	lbs.	Rolled Barley	6.75	59.5	$0.900
50	"	Corn Meal	3.75	42.9	0.825
100	"	Wheat Bran	12.50	60.9	1.250
10	"	Coconut Oil Cake Meal	1.99	7.1	0.165
5	"	Linseed Oil Cake Meal	1.58	3.8	0.097
3	"	Raw Rock Phosphate	---	---	0.046
3	"	Salt	---	---	0.021
246	"	Mixture	26.57	174.2	$3.304
100	"	"	10.80	70.80	1.34

HP Ration (High Protein)

			Pounds Digestible		Actual
			Protein	Total Nutrients	Cost
400	lbs.	Soybean Oil Cake Meal	158.8	338.0	$ 6.60
480	"	Wheat Bran	60.0	292.3	6.00
300	"	Rolled Barley	27.0	238.2	3.60
15	"	Raw Rock Phosphate	---	---	.23
15	"	Salt	---	---	.10
1210	"	Mixture	245.8	868.5	$16.53
100	"	"	20.2	71.8	1.36
2	"	Beet Pulp	.092	1.432	.029

It will be noted that the high protein ration carried almost twice as much protein as did the normal ration. When ten pounds of each were fed along with the same roughages and beet pulp, the high protein ration supplied about 50 per cent more protein than did the normal ration.

X Ration (normal protein mixture)

		Pounds Digestible Protein	Pounds Digestible Total Nutrients	Actual Cost
75 lbs.	Rolled Barley	6.75	59.5	$0.500
50 "	Corn Meal	3.75	42.9	0.825
100 "	Wheat Bran	12.50	60.9	1.250
10 "	Coconut Oil Cake Meal	1.99	7.1	0.165
5 "	Linseed Oil Cake Meal	1.58	3.8	0.097
5 "	Raw Rock Phosphate	---	---	0.046
5 "	Salt	---	---	0.021
246 "	Mixture	26.57	174.2	$3.304
100 "	"	10.80	70.80	1.34

RP Ration (High Protein)

		Pounds Digestible Protein	Pounds Digestible Total Nutrients	Actual Cost
400 lbs.	Soybean Oil Cake Meal	158.6	298.0	$ 5.60
150 "	Wheat Bran	6.0	29.6	6.00
300 "	Rolled Barley	27.0	238.8	3.60
15 "	Raw Rock Phosphate	---	---	.23
15 "	Salt	---	---	.10
1870 "	Mixture	215.6	568.5	$16.53
100 "	"	20.2	71.8	1.30
2 "	Beet Pulp	.092	1.452	.029

It will be noted that the high protein ration carried almost twice as much protein as did the normal ration. When ten pounds of each were fed alone with the same roughage and beet pulp, the high protein ration supplied about 50 per cent more protein than did the normal ration.

Cows Used in This Test

	Cow No.	Age	Days since calving to 4-30-32	Due to calve	Average production on Apr. 3, 11, 17
Lot A	88H	4½	34	---	42.6 lbs.
	51G	9	53	---	33.6 "
	110H	2½	62	---	23.9 "
	79H	5	253	12-28-32	20.3 "
Average		5	100		30.1 "
Lot B	42H	10	29	---	35.6 lbs.
	102H	3½	5	---	30.0 "
	74H	6	212	11- 1-32	26.0 "
	108H	3	108	---	23.1 "
Average		5½	90		28.7 "

Feeding Schedule

X - Check or normal protein ration
HP - High protein ration

Cow Number	Lot A				Lot B			
	88	51	110	79	42	102	74	108
Inclusive days 1932								
Apr. 28 - June 1	X	X	X	X	HP	HP	HP	HP
June 2 - July 6	HP	HP	HP	HP	X	X	X	X
July 7 - Aug. 10	X	X	X	X	HP	HP	HP	HP

Aug. 11 - Returned to ration fed previous to April 28, 1932.

Body Weight of Cows

The eight cows were weighed at the beginning of the test period and every week thereafter on the same day throughout the test. They were weighed in the afternoon after being fed and milked.

Lot A averaged 915.0 pounds on X ration and 926.2 pounds on HP ration, a difference of 11.2 pounds in favor of the HP ration. Lot B averaged 976.9 pounds on the X ration and 977.2 pounds on the HP ration; a slight difference in favor of the HP ration. Considering the averaged weights of all the cows on the X ration (945.9 pounds) and the HP ration (951.7 pounds), there is a difference of 5.8 pounds in favor of the HP ration.

Individually, four cows averaged 20.6 pounds heavier on the HP ration and four cows averaged 9.1 pounds more when on the X ration.

Butter Fat Tests

Composite samples of four consecutive milkings were tested in duplicate every week on the same day, but only the results of the tests made during the last four weeks of each period are included in these averages.

The butter fat tests of all cows on the X ration averaged 3.66 per cent, while those on the HP ration averaged 3.73 per cent, a difference of .07 per cent in favor of the HP ration. Individually, six cows showed an increase of fat on HP ration ranging from .02 per cent to .26 per cent, or an average increase of .12 per cent per cow. Two cows on X ration showed an averaged increase of .18 per cent.

Milk Production and Costs of Different Feeds

The most important details of production, amount of feed fed daily, costs, etc. are shown in the following condensed table.

	Group A		Group B		Both Groups	
	on X-Feed	on HP-Feed	on X-Feed	on HP-Feed	on X-Feed	on HP-Feed
Average lbs. milk per cow per day	26.98	27.29	25.42	26.44	26.20	26.86
Average per cent butter fat	3.72	3.74	3.60	3.72	3.66	3.73
Total lbs. concentrates fed per cow per day	12.87	12.96	12.48	12.42	12.67	12.69
Lbs. milk produced per lb. of concentrates fed	2.10	2.11	2.04	2.13	2.07	2.12
Roughage cost per cow per day	17.9¢	15.8¢	15.8¢	17.9¢	16.9¢	16.9¢
Feed cost per 100 lbs. milk	$1.31	$1.23	$1.29	$1.32	$1.30	$1.28
Feed cost per pound of butter fat	$ .352	$ .330	$ .358	$ .355	$ .355	$ .342

X = Check Ration HP = High Protein Ration

Summary

Cows when on the high protein feed averaged 5.8 pounds more weight than when on the normal protein feed. This is probably an insignificant difference.

The cows on high protein feed averaged 3.73 per cent butter fat and on the normal ration 3.66 per cent fat. Six cows showed a slight individual increase on high protein feed, while two cows showed a slight increase on the normal protein feed mixture. The differences noted are probably not significant.

The averaged daily milk production for all cows was 26.20 and 26.86 pounds at a total feed cost of $1.30 and $1.28 per hundred pounds of milk for the normal protein feed and the high protein feed respectively.

	Group A		Group B		Both Groups	
	on X-Feed	on HP-Feed	on X-Feed	on HP-Feed	on X-Feed	on HP-Feed
Average lbs. milk per cow per day	26.98	27.29	25.42	26.44	26.20	26.86
Average per cent butter fat	3.72	3.74	3.60	3.72	3.66	3.73
Total lbs. concentrates fed per cow per day	12.87	12.96	12.46	12.62	12.67	12.69
lbs. milk produced per lb. of concentrates fed	2.10	2.11	2.04	2.13	2.07	2.12
Roughage cost per cow per day	16.94	16.84	16.84	17.94	16.94	16.94
Feed cost per 100 lbs. milk	$1.31	$1.25	$1.30	$1.25	$1.30	$1.25
Feed cost per pound of butter fat	.352	.330	.361	.339	.356	.342

X = Check Ration HP = High Protein Ration

Summary

Cows when on the high protein feed averaged 5.5 pounds more weight than when on the normal protein feed. This is probably an insignificant difference.

The cows on high protein feed averaged 3.73 per cent butter fat and on the normal ration 3.66 per cent fat. Six cows showed a slight individual increase on high protein feed, while two cows showed a slight increase on the normal protein feed mixture. The differences noted are probably not significant.

The averaged daily milk production for all cows was 26.20 and 26.86 pounds at a total feed cost of $1.30 and $1.28 per hundred pounds of milk for the normal protein feed and the high protein feed respectively.

The cost per ton of the normal protein feed (10.80 per cent digestible crude protein) and the high protein feed (20.2 per cent digestible crude protein) was $26.80 and $27.20 respectively, indicating that in Hawaii some high protein feeds cost very little more than feeds with a much lower protein content.

The economy of production was essentially the same with both feeds, the milk production costs being 1.56 per cent lower with the high protein feed--an insignificant difference.

This experiment does not confirm the opinion frequently expressed by Hawaii dairymen that protein feeding in excess of the Morrison standard is necessary for maximum milk yields. However, at price levels obtaining at the time of the experiment, the high protein ration costs no more than the normal protein ration.

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The cost per ton of the normal protein feed ($30.80 per cent digestible crude protein) and the high protein feed ($30.5 per cent digestible crude protein) was $26.80 and $27.20 respectively, indicating that in Hawaii some high protein feeds cost very little more than feeds with a much lower protein content.

The economy of production was essentially the same with both feeds, the milk production costs being 1.5% per cent lower with the high protein feed--an insignificant difference.

This experiment does not confirm the opinion frequently expressed by Hawaii dairymen that protein feeding in excess of the Morrison standard is necessary for maximum milk yields. However, at price levels obtaining at the time of the experiment, the high protein ration costs no more than the normal protein ration.

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